REMARKS/ARGUMENTS

Claims 1-25 were previously pending in the application. Claims 6, 16, 18, and 21-23 are canceled; claims 1-6, 9, 11-15, 17, 19-20, and 24-25 are amended; and new claims 26-31 are added herein. Assuming the entry of this amendment, claims 1-5, 7-15, 17, 19-20, and 24-31 are now pending in the application. The Applicant hereby requests further examination and reconsideration of the application in view of the foregoing amendments and these remarks.

Support for new claims 26-31 is as follows:

New Claim	Support
26	Previously pending claim 16 and Fig. 3
27	Previously pending claim 2
28	Previously pending claim 17
29	Previously pending claim 1 and Fig. 3
30	Previously pending claim 2
31	Previously pending claim 17

Due to the extent of the amendments, the following list showing clean versions of claims 1-25 is provided as a courtesy to the Examiner.

1. (clean version) A method for code-tracking in a CDMA communication system, the method comprising:

(a) receiving an electromagnetic signal (10) comprising a superposition of a plurality of signal components of different signal paths corresponding to a particular transmitted user signal that was spread with a particular code sequence,

(b) digitizing (14) the received signal (10,13),

(c) distributing the digitised signal (15) to a plurality of receiver fingers (1, 2, ... N) of a rake receiver, each finger being assigned to a different one of the signal paths,

(d) distributing the digitised signal (110, 111) in each finger to a detection stream and a synchronizing stream,

(e) decorrelating (121, 122) the digitised signal in a first finger of the rake receiver corresponding to a first signal path using the particular code sequence (112) in the synchronizing stream to generate a first decorrelated signal for the first signal path corresponding to the first finger, and

(f) reducing the interference of at least one other signal component of at least one other signal path corresponding to at least one other finger of the rake receiver with the signal component of the first signal path corresponding to the first finger by:

calculating the interference contribution of the at least one other finger in the first finger; and

subtracting, for the first signal path, the interference contribution of the at least one other finger from an intermediate signal derived from the first decorrelated signal.

2. (clean version) A method according to claim 1, wherein step (f) further comprises the steps of:

storing an S-curve for the CDMA communication system in an interference computation module; and

calculating the interference contribution of the at least one other finger in the first finger by multiplying a total weight of an interfering path corresponding to the at least one other finger by the S-curve at an estimated correct location.

3. (clean version) A method according to claim 1 wherein the subtracting takes place on symbol rate (1/T).

4. (clean version) A method according to claim 1, wherein interference of other signal components ($j \neq i$) than the first signal component (i) is reduced in all receiver fingers (1, 2, ... N).

5. (clean version) A method according to claim 1, wherein step e) comprises decorrelating (121, 122) the digitised signal by multiplying the digitised signal with a complex-conjugate pseudo-noise code sequence (112).

6. (canceled)

7. (clean version) A method according to claim 1, wherein after step f) the real part (118, x) of the interference reduced complex signal (y) is determined (126).

8. (clean version) A method according to claim 1 wherein before step f) the real part (x) of the complex signal (116, y) is determined.

9. (clean version) A method according to claim 1, wherein after step f) the interference reduced signal (118, X) is filtered in a further step.

10. (clean version) A method according claim 9, wherein steps e), f) and the filtering step provide code-tracking (101) of the digitised signal (111).

11. (clean version) A method according to claim 10, wherein the code-tracking (101) provides an estimated timing delay ($\tau_k^{(i)}$) of the signal component of the first signal path (i).

12. (clean version) A method according to claim 1 wherein prior to step f) the digitised signal (111) is distributed to a first and second correlator (121, 122).

13. (clean version) A method according claim 12, wherein the digitised signal (111) is time-shifted prior to feeding it to the second correlator (122) providing late and early estimates (113, 114) as output of the first and second correlators (121, 122) respectively.

14. (clean version) A method according to claim 13, wherein the early and late estimates are subtracted (124) yielding a difference signal.

15. (clean version) A method according to claim 14, wherein the difference signal is multiplied with reconstructed transmitted symbols (115) to generate the intermediate signal.

16. (canceled)

17. (clean version) A rake receiver (17) according claim 26, wherein the interference reduction device (131) comprises an interference computation module (132) being adapted to receive complex path weights ($c_k^{(i)}$) and path delays ($\tau_k^{(i)}$, $\tau_k^{(j)}$) to compute the interference contribution of the at least one other signal component with the said signal component of the first signal path.

18. (canceled)

19. (clean version) A rake receiver (17) according to claim 26, comprising an A/D-converter (14) upstream of the receiver fingers (1,2 ... N), for digitizing the received signal (10, 13).

20. (clean version) A rake receiver (17) according to claim 26, wherein the timing error detector (102) is an early-late gate timing error detector further comprising a second correlator adapted to decorrelate another version (123) of the digitized signal to generate a second decorrelated signal, wherein the intermediate signal is generated based on the two decorrelated signals.

21-23. (canceled)

24. (clean version) A rake receiver (17) according to claim 26, wherein the timing error detector (102) is adapted to provide pseudo-noise (112) decorrelation (121, 122).

25. (clean version) A rake receiver (17) according to claim 26, which is adapted for direct-sequence code-division multiple access communication.

An earlier version of this amendment, which did not change the substance of the claims, was informally faxed to the Examiner on 10/30/05, and a telephonic interview was held between the Examiner and the Applicant's below-named attorney Steve Mendelsohn on 10/31/05. The Applicant thanks the Examiner for the courtesy of that interview. During the interview, the Examiner stated that, if the earlier version of the amendment were formally filed, it would not overcome the prior-art rejections and an advisory action would be issued. As such, the Applicant is filing the present amendment with substantive changes to the claims as part of an RCE.

Claim Objections

In paragraph 1 of the final office action, the Examiner objected to claims 1-25 because of certain informalities.

Regarding the Examiner's objection to claim 1, the Applicant has amended claim 1 to clarify that what had been referred to as steps (g) and (i) in the previously pending version of claim 1 are part of step (f). In addition, the Applicant has amended claim 1 to clarify that step (f) is directed to "reducing the interference of at least one other signal component of at least one other signal path corresponding to at least one other finger of the rake receiver with the signal component of the first signal path corresponding to the first finger."

Regarding the Examiner's objection to claim 2, the Applicant has amended claim 2 to clarify that the interference contribution of finger j in finger i is calculated "by multiplying a total weight of an interfering path corresponding to the at least one other finger by the S-curve at an estimated correct location." As described on page 14, line 27, to page 15, line 2, an S-curve, such as that shown in Fig. 4, is a detector characteristic for the coherent timing error detector, where the S-curve depends on the pulse filter used in the transmitter and the corresponding matched filter (e.g., 12 of Fig. 1) in the receiver. As described starting on page 17 and as specifically defined on line 24 of page 17, the term "estimated correct location" refers to an estimate of the time delay difference between fingers i and j, where the normalized time delay difference is represented by the X axis in Fig. 4. The interference contribution of finger j in finger i is calculated by multiplying the value of the S-curve (e.g., in the Y direction in Fig. 4) at the estimated correct location by the total weight (e.g., $c_k^{(i)*} c_k^{(j)}$ in Equation (1)) of the interfering path j in signal path i.

Regarding the Examiner's objection to claim 3, the Applicant has amended claim 3 as suggested by the Examiner.

Since claim 16 has been canceled, the Examiner's objection to claim 16 is moot.

The Applicant submits that this passage was inaccurately presented in the claims listed in the previous amendment.

Claims 1, 5, 9, 11, 13, and 17 have been amended to restore certain passages in those claims to their original form when the application was filed, where those passages were inaccurately presented in the claims listed in the previous amendment.

Specification

In paragraph 2, the Examiner objected to the disclosure. In response, the Applicant has amended the specification as suggested by the Examiner. In addition, the Applicant has amended the specification to add a section heading for the Summary of the Invention.

Claim Rejections - 35 USC 112

In paragraph 4, the Examiner rejected claim 2 under 35 U.S.C. 112, second paragraph, as being indefinite. In response, the Applicant has amended claim 2 to correct the antecedence problem.

Drawings

In paragraph 5, the Examiner objected to the drawings, suggesting that "the fingers (1, 2,.. N)" are not shown in the drawings. In response, the Applicant submits that Fig. 1 represents the N fingers of rake receiver 17 by the N sets of samples 110 being provided to via the detection path to fingers 1, 2, ..., N and by the N code-tracking loops 101, 201, 301, where each finger has a detection path and a corresponding code-tracking loop. See, e.g., page 9, lines 9-12, and page 10, line 28, to page 11, line 3. As such, the Applicant submits that the objection to the drawings has been overcome and that no corrected drawing sheets are required.

Claim Rejections - 35 USC 103

In paragraph 7, the Examiner rejected claims 1 and 3-15 under 35 U.S.C. 103(a) as being unpatentable over Huang in view of Popovic. In paragraph 8, the Examiner rejected claims 16 and 18-25 under 35 U.S.C. 103(a) as being unpatentable over Huang in view of Tran. In paragraph 9, the Examiner indicated that claim 2 would be allowable if rewritten to overcome the rejection(s) under Section 112, second paragraph, and to include all of the limitations of the base claim and any intervening claims. In paragraph 10, the Examiner objected to claim 17 as being dependent upon a rejected base claim, but indicated that that claim would be allowable if rewritten in independent form. For the following reasons, the Applicant submits that all of the now-pending claims are allowable over the cited references.

Claim 1 has been amended to clarify the differences between the present invention and the teachings in the cited references, especially Huang. According to currently amended claim 1, the digitised signal is decorrelated in a first finger of the rake receiver corresponding to a first signal path using the particular code sequence to generate a first decorrelated signal for the first signal path corresponding to the first finger. The interference of at least one other signal component of at least one other signal path corresponding to at least one other finger of the rake receiver with the signal component

of the first signal path corresponding to the first finger is reduced by (1) calculating the interference contribution of the at least one other finger in the first finger and (2) subtracting, for the first signal path, the interference contribution of the at least one other finger from an intermediate signal derived from the first decorrelated signal.

One significant difference between the present invention and the teachings in Huang is that the present invention is directed to a technique for reducing interference between different fingers within a single rake receiver corresponding to a single user signal that was spread using a single code sequence, while Huang is related to a technique for reducing interference between different rake receivers corresponding to different user signals spread using different code sequences.

In rejecting previously pending claim 1, the Examiner stated that Huang teaches "calculating the interference contribution of finger J in finger I," citing elements 122 and 164, and "subtracting the interference contribution of the at least one other finger from an intermediate signal." The Applicant submits that the Examiner has mischaracterized the teachings of Huang in rejecting claim 1.

As described in column 5, line 50, to column 6, line 31, Huang teaches, in Fig. 3A, a CDMA RAKE receiver 50 having a multi-user interference cancellation unit 110, which "removes the reconstructed interference signals from other users from the signal R[k] by using a first adder 122 and a second adder 124." (emphasis added). The first adder 122 "combines the reconstructed interference signals from other users to generate the total reconstructed interference signal" based on "the reconstructed interference signal generated by the uplink receiver of the j'th user" (emphasis added). "After gathering the reconstructed interference signals generated from the uplink receivers of other users, the second adder 124 subtracts [the total reconstructed interference signal] from the signal R[k] to produce a signal $R1_i[k]$," which is then "transmitted through the data signal spreading code matched filter 112," which "removes (despreads) the data signal spreading code."

As clearly taught in Huang, cancellation unit 110 removes interference signals corresponding to other users based on reconstructed interference signals generated from other rake receivers. Huang's cancellation unit does not remove interference signals corresponding to other fingers within the same rake receiver corresponding to a single user signal.

Huang's data signal spreading code matched filter 112 is analogous to correlator 120 in Figs. 2-3 and 6-7 of the present application. Note that Huang's cancellation unit 110 is upstream of matched filter 112, while the interference cancellation of the present invention (e.g., step (f) of claim 1) is implemented after the signal has been decorrelated (e.g., step (e) of claim 1). See also, e.g., Fig. 3, where interference reduction device 131 is downstream of correlators 121 and 122. If Huang's cancellation unit 110 were to be implemented in the context of the rake receiver represented in Fig. 3 of the present application, it would be implemented between digital interpolator/decimator 16 and correlator 120 (i.e., before the signal is decorrelated).

In an ideal situation in which there is no interference between different user signals, when a multi-user signal such as a CDMA signal is correlated (i.e., despread) using the spreading code assigned to a particular user (e.g., PN code 112 of Fig. 3 of the present application and $C_d^*[k]$ of Fig. 3A of Huang), the resulting despread signal will contain only the signal corresponding to that particular user. The purpose of Huang's cancellation unit 110 is to remove interference from other users prior to performing the despreading operation in order to get as close to that ideal situation as possible.

The present invention addresses an entirely different type of interference. Rather than dealing with interference between different users, the present invention addresses interference between different

multi-path versions of the signal associated with a single user, where each different version corresponds to a different signal path from the transmitter to the receiver. See, e.g., page 5, line 21, to page 6, line 1, of the specification. In a rake receiver of the present invention, each finger corresponds to a different signal path for the <u>same</u> user signal. The interference cancellation of the present invention is related to reducing interference that can exist between different <u>fingers</u> in a rake receiver. This is very different from the teachings of Huang, which are related to reducing interference that can exist between different <u>users</u> in a multi-user signal.

Significantly, Huang's cancellation technique would simply not work if Huang's cancellation unit 110 were placed after Huang's matched filter 112. As such, it would be improper to suggest that Huang's cancellation technique could be modified to provide the present invention since such modification would destroy the functionality of Huang's system.

For all these reasons, the Applicant submits that the Examiner mischaracterized the teachings of Huang in rejecting claim 1. The other cited references do not provide the teachings missing from Huang.

In view of the foregoing, the Applicant submits that currently amended claim 1 is allowable over the cited references. For similar reasons, the Applicant submits that new claims 26 and 29 are allowable over the cited references. Since the rest of the claims depend variously from claims 1, 26, and 29, it is further submitted that those claims are also allowable over the cited references. The Applicant submits therefore that the rejections of claims under Section 103(a) have been overcome.

In view of the above amendments and remarks, the Applicant believes that the now-pending claims are in condition for allowance. Therefore, the Applicant believes that the entire application is now in condition for allowance, and early and favorable action is respectfully solicited.

Respectfully submitted,

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